

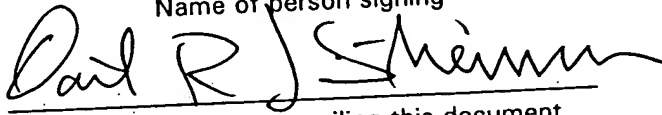
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**TITLE OF THE INVENTION**

Pack Support with Frictional Load Transfer

## CROSS REFERENCES TO RELATED APPLICATIONS

[0001] Not applicable.

STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER  
FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

[0002] The U.S Government has a paid-up license in this invention and the right in  
limited circumstances to require the patent owner to license others on reasonable terms  
5 as provided for by the terms of contract No. DAAD16-01-C-0061 awarded by the US  
Army Robert Morris Acquisition Natick Contracting Division of the United States  
Department of Defense.

## BACKGROUND OF THE INVENTION

[0003] The present invention relates to systems for transporting loads in general, and more particularly to systems for human back-mounted support of loads.

5 [0004] Although significant loads are conventionally transported by automated machinery such as automobiles, airplanes, boats and trains, there are still important applications where it is necessary for a single person, unassisted, to transport material and supplies which must be readily at hand. Explorers, sport travelers, mountaineers, park rangers, and others who travel away from established roads must often carry loads over terrain which is impassable by automated equipment and which may not even be  
10 accessible by pack animals. Soldiers and police officers also must bring supplies, weapons, and materiel into unpaved regions under challenging conditions.

[0005] Backpacks and haversacks provide containers which are supported on one or both shoulders, and allow the user to carry significant loads of 30–100 pounds or more. External frame backpacks employ stiff tubular supports for the load, and commonly  
15 have a waist belt which secures the pack at the waist to remove some of the load from the user's shoulders and place it on the user's waist or hips. By transferring some of the load to the user's waist, the weight on the user's back is reduced, and hence the carrying of greater loads for greater distances is made possible. However, by strapping the pack to the waist, the wearer is limited in his flexibility and mobility.

20 [0006] When conditions call for rapid or limber movements, a backpack which is fixed to the wearer's waist can be a distressing impediment; and, in the case of military or police use, hazardous.

[0007] What is needed is carrier system which aids a user in extended transport of loads, while permitting unrestricted movement on demand.

## SUMMARY OF THE INVENTION

[0008] The carrier system of this invention transfers loads from a shoulder mounted assembly to a waist mounted assembly by purely frictional engagement between two stiff structures. At any time the user can bend forward to instantly break the frictional connection. The wearable load supporting system has a rigid back plate which is supported over the shoulders of a user, and which may be a part of a backpack or carrier system, or may be incorporated within an armored vest. The back plate has an upper segment which extends downwardly over padding, and which terminates in a downwardly and rearwardly extending lower segment. A waist belt is secured around the user's waist, and mounts a rearwardly facing rigid waist plate. When the user is upright, a high friction surface on the lower segment of the back plate engages a high friction surface on the waist plate, to thereby transfer vertical loads from the back plate to the waist plate. However, if the user bends forwardly, the connection between the high friction surfaces is broken. Although the loads are no longer transferred to the user's waist, neither is the user's mobility restricted. The high friction surfaces may be natural or artificial rubber, or mechanically engaging surfaces arranged such that sliding motion between the back plate and the waist plate are restricted by the friction load transfer surfaces, without restricting the pulling away of the back plate from the waist plate in a direction generally perpendicular to the engaged friction load transfer surfaces.

[0009] It is a feature of the present invention to provide a load carrying system which effectively transfers a portion of the load to the waist of the user or permits the user to lean forward without restriction.

[0010] It is another feature of the present invention to provide a ballistic protection vest which incorporates load transfer capabilities.

[0011] Further features and advantages of the invention will be apparent from the following detailed description when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a side elevational view, partially broken away in section, of the pack support system of this invention, with an alternate position of the user shown in phantom view.

5 [0013] FIG. 2 is an exploded isometric view, partially broken away, of the system of FIG. 1.

[0014] FIG. 3 is an isometric view of the fastener which connects the pack to the shell of the system of FIG. 1.

10 [0015] FIG. 4 is a schematic side elevational view showing the fastener of FIG. 3 while supporting loads.

[0016] FIG. 5 is a schematic side elevational view of the fastener of FIG. 4 being disengaged.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Referring more particularly to FIGS. 1–5, wherein like numbers refer to similar parts, a pack support system 20 is shown in FIGS. 1 and 2. The pack support system 20 has a shoulder mounted assembly 26 and a waist mounted assembly 28 which cooperate to transfer loads from the shoulder mounted assembly to the waist mounted assembly under certain conditions.

[0018] The system 20 is illustrated as incorporating a ballistic protection vest, such as the one disclosed in U.S. Patent Application No. 10/255,157, filed September 25, 2002, the disclosure of which is incorporated by reference herein. The vest may incorporate soft armor and hard armor plates. The shoulder mounted assembly has a rigid back plate 30. The rigid back plate is preferably used in conjunction with a load transferring shell 48 or carapace. The shell is formed by two side vest sections 34 which are connected to the front plate and the back plate. The shell serves to evenly distribute the supported loads over the user. The back plate 30 is fastened to the rear of the shell 48 by adjustable straps. The straps may be adjustably received within loops, or a slot and tab arrangement may be employed. It should be noted that the rigid plates will typically be encased in fabric pockets, which make it possible to readily attach fabric straps and fasteners thereto. The shell 48 may be formed of flexible, thin aluminum, or PVC plastic, or High Density Polyethylene or, in ballistic applications, of the ballistic material known as Spectra. It could be a 3-D molded sheet, or formed of flat sheet material into which bends have been formed.

[0019] The side vest sections 34 of the shell 48 have two shoulder straps 32 connected to two flexible vest side parts 34 which are connected to a front plate 36, best shown in FIG. 2. In a ballistic protection vest, the front plate 36 and the back plate 30 will have ballistic protection characteristics. If only the load carrying features of the system are required, the rigid front plate need not be included, but in any event the back plate 30 will be of rigid material. Thus, although the back plate 30 may be composed of a



hardened lay-up of ballistic materials, it could also be formed of aluminum, carbon fiber, fiberglass, a thermoplastic material such as ABS plastic 1/8 inch thick or thicker, and it could be reinforced with glass fibers. Although there may be a small amount of flex in the plate, it should be generally rigid and not floppy like a fabric. The back plate 30 may also be a composite structure, for example plastic reinforced with metal spars, such as ABS plastic with 1/8 inch thick aluminum spars. As shown in FIG. 2, the back plate has a distinct curvature about several horizontal axes, as discussed in more detail below. It may also have a slight curvature about a vertical axis, to conform somewhat to the back of a user 21, although that is not necessary. Although shown as generally featureless, the back plate could also be formed with stiffening ribs or corrugations, to permit increased stiffness at reduced weight.

[0020] The back plate 30 is connected by the vest side parts of the shell to the shoulder straps 32, and hangs downwardly in engagement with the user's back. The shell is made of a material similar to the shoulder strap material. The back plate is cushioned against the user's back by one or more back pads 38 on the vest parts 34. The back pads 38 may be of conventional padding material, such as closed cell foam, or a combination of open and closed cell foam. The shoulder straps and the vest parts 34 are not as stiff as the back plate, but are not as loose as fabric. The vest parts 34 may be formed of, for example, polyethylene or a flexible plastic material, similar to a football uniform shoulder pad material, which is capable of transferring some load, and distributing it evenly over the wearer's shoulders. Shoulder pads 40 of material similar to the back pads 38 cushion the shoulder straps 32 where they engage the user.

[0021] As best shown in FIG. 1, the back plate has an upper segment 42 which extends downwardly and frontwardly, as worn, and is supported by the back pads 38 against the user's back. The upper segment 42 may be somewhat concave as it faces frontwardly, such that it has a top portion 44 which projects frontwardly to extend along the upper portion of the wearer's back. The back plate 30 has a lower segment 46 which

extends downwardly and rearwardly from the upper segment. The angle between the upper segment 42 and the lower segment 46 of the back plate is less than 180 degrees, and more than 90 degrees, preferably about 120 degrees.

5 [0022] The lower segment 46 of the back plate extends rigidly from the upper segment 42, and is faced with a high friction material which defines a frontwardly facing friction load transfer surface 50 which is positioned to engage against a similar high friction material on the waist mounted assembly 28. Although the upper segment 42 may have a slight curve about a generally vertical axis, the lower segment is preferably without a curve.

10 [0023] The waist mounted assembly 28, as shown in FIG. 2 has a flexible fabric belt 52 which may have a conventional quick release buckle fastener 54 in front, and which loops around the user's waist. Fixed to the rear of the flexible belt 52 is a rigid waist plate 56, which may be made of a material similar to the material from which the back plate is formed. If the back plate lower segment has a curve about a generally vertical axis, then the rigid waist plate may have a matching curve. However, both the back plate  
15 lower segment and the waist plate 56 are preferably planar plates. A waist pad 58 is mounted to the belt 52 frontwardly of the waist plate 56, and cushions the bearing of the waist plate against the user 21. The waist plate 56 is faced with a high friction material which defines a rearwardly facing friction load transfer surface 60 which is positioned to  
20 engage against the similar high friction material on the lower segment 46 of the back plate. As shown in FIG. 1, the waist plate 56 faces generally rearwardly, and may face slightly upwardly, while the back plate lower segment faces frontwardly and slightly downwardly.

25 [0024] The material which presents the high friction load transfer surfaces 50, 60, on the lower segment 46 of the back plate 30 and on the waist plate 56, may be a material with an inherently high coefficient of friction such as synthetic or natural rubber, or

urethane, or the rubber from which automobile tires are made, or some viscoelastic material, or it could be the GREPTILE™ material formerly manufactured by 3M of Minneapolis, Minnesota. Alternatively, the material may not be inherently high friction, but may highly textured mechanical structure formed thereon which causes two sheets  
5 of the formed material to resist shear, but to have substantially no resistance to being peeled apart or pulled apart. For example, the material may be formed with microscopic projecting fingers, or small pyramids which mate with one another.

[0025] A pack 62 is removably attached to the system 20 by straps or other connectors which fasten it to the shell. Adjustable upper straps 64, and lower straps 66 connect the  
10 pack to the side vest parts and the front plate, as shown in FIG. 2. Hence, in use, the pack is secured to the shell 48 and restrained from moving freely with respect to the user's upper body. The secure engagement of the pack to the shell prevents its movement with respect to the back plate. It will be noted that the pack 62 is not fastened directly to the user's waist, but only through the frictional connection of the high  
15 friction load transfer surfaces 50, 60. The pack may be of a modular design, so that various packs of different configuration can be received on the same back plate, permitting the rapid exchange of loads between various users.

[0026] The connection between the pack 62 and the shell 48 may be provided by a variety of conventional fastener such as carabiners, or sideways buckles, but the  
20 connection is preferably provided by quick release fasteners 68, such as those shown in FIGS. 3-5. Each fastener 68 has a plastic body 70 which is generally C-shaped having a first member 72 connected by an end piece 74 to a second member 76 spaced from the first member. A semi cylindrical slot 78 is defined between the first member 72 and the second member 76 within the end piece 74, the slot is dimensioned to tightly engage a  
25 particular cylindrical bar. The second member 76 defines a ramp 80 which leads into the slot 78. The body 70 may be formed of nylon, or delrin plastic material, and will therefore elastically deform to engage the cylindrical bar 82 of a metal ring 84. The ring

84 may be connected by a fabric loop 86 in a conventional fashion to the shell 48. The first member 72 has an upper opening 88 which receives a strap upon which a load to be carried is applied. A forward opening 90 is formed in the body end piece 74 which receives a handhold loop 92. As shown in FIG. 4, in use, loads are applied by a strap to the first member 72 of the body 70 and are carried thereby to the ring 84 and from there to the fabric loop 86 and the shell 48. When it is desired to disconnect the fastener 68, the user engages the handhold loop 92 and pulls away from the ring 84, causing the body 70 to pivot about the ring bar 82 until the bar may be disengaged from the semicylindrical slot 78. The fasteners 68 may be positioned on the upper portion of the shoulder straps or the shell front to receive the straps 64, as well as on the front plate of the shell to receive the sidewardly and rearwardly extending straps 66.

[0027] As shown in FIG. 1, when the user 21 stands upright, with the pack 62 affixed to the back plate 30, the friction load transfer surfaces 50, 60, on the lower segment 46 of the back plate 30 and on the waist plate 56 engage one another, and, because of the high frictional engagement between the two surfaces, there is no shear between the engaged surfaces, and hence vertical loads are transferred from the back plate to the waist plate and hence the waist belt 52 and to the user's waist. However, if a particular orientation becomes uncomfortable, the user need only lean forward slightly, as indicated in the phantom view of FIG. 1, to completely separate the back plate 30 from the waist plate 56. The connection between the back plate and waist plate may then be adjusted when the user again stands upright. The high frictional engagement between the surfaces provides substantially no resistance to pulling or peeling apart the two plates, and hence they are readily and easily adjusted in their engagement. Moreover, if the user needs to make a sudden forward bending movement, the connection between the shoulder mounted assembly and the waist mounted assembly provides no impediment to this motion. This freedom of movement can be especially important in military and police maneuvers where threats may appear unexpectedly and suddenly from any direction, requiring a rapid response. Depending on how high the frictional

engagement is between the friction load transfer surfaces, a high level of the back load can be successfully transferred to the waist.

[0027] It is understood that the invention is not limited to the particular construction and arrangement of parts herein illustrated and described, but embraces all such  
5 modified forms thereof as come within the scope of the following claims.